Life Science Journal

Websites:
http://www.lifesciencesite.com
http://www.sciencepub.net

Emails:
editor@sciencepub.net
sciencepub@gmail.com

MARSLAND PRESS
Multidisciplinary Academic Journal Publisher

Effect Of Hypobaric Treatment And Storage Temperature On Shelf Life Of Persimmon Fruit

Fouzia Bibi[1], Ali Muhammad[1], Muhammad Umair Khalid[2], Mahwish Shaukat[3], Umair Ahmad[4], Zahra Batool[2], Maha Khan[2], Bushra Farooq[2], Rameesha Anjum[2], Zahra Nishat[2]

[1] Department of Food Science & Technology, The University of Agriculture Peshawar, Pakistan
[2] National Institute of Food Science & Technology, University of Agriculture, Faisalabad, Pakistan
[3] Department of Food Science & Technology, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan
[4] Department of Chemistry, University of Engineering and Technology, Lahore, Pakistan
Email: alizypher@yahoo.com

Abstract: Persimmon fruit can soften rapidly within days, sometimes even hours. This softening is initially triggered by ethylene (a natural plant hormone), which is initial trigger for a range of fruit softening enzymes such as polygalacturnase (PG) and pectinesterase (PE) The research was carried out to study the effect of hypobaric treatment and storage temperature on shelf life of persimmon fruits for a period of 8 days. The treatments were T0 (Control), T1 (0•C), T2 (23•C+25 kPa) and T3 (0•C + 25kPa). The samples were analysed physic-chemically for (Firmness, Weight Loss, Shrinkage and TSS) and organoleptically for flavour. T1 showed lower (18.52 ^{o}Brix) TSS during 8 days of storage followed by T3 (19.00^{o}Brix), T0 (19.12 ^{o}Brix) and T2 (19.32 ^{o}Brix). Shrinkage was minimum in T3 (2.61 %) and maximum in T2 (4.10 %) while T1 and T0 showed (1.61 %) and (3.49 %) respectively. Loss in firmness was maximum in T0 (0.92 N) while minimum in T2 (1.30 N). T1 showed higher weight loss (3.58%) followed by T2 (3.37%), T1 (1.62%) while T3 showed minimum weight loss of (0.55%). After storage days T1 obtained maximum score for flavour (7.00) followed by T3 (6.50), T2 (5.20) and T0 (4.70). By analysing above information it was concluded that T3 is effective in extending shelf life of persimmon fruits.
[Fouzia Bibi, Ali Muhammad, Muhammad Umair Khalid, Mahwish Shaukat, Umair Ahmad, Zahra Batool, Maha Khan, Bushra Farooq, Rameesha Anjum, Zahra Nishat. **Effect Of Hypobaric Treatment And Storage Temperature On Shelf Life Of Persimmon Fruit.** *Life Sci J* 2021;18(2):55-60]. ISSN: 1097-8135 (Print) / ISSN: 2372-613X (Online). http://www.lifesciencesite.com. 9. doi:10.7537/marslsj180221.09.

Key words: hypobaric treatment, temperature, shelf life, persimmon fruit

I. Introduction

Persimmon (*Diospyrose Kaki*) was first originated in China and then introduced in Japan that is why it is called as Japanese persimmon. It is deciduous medium size tree. It was originated in China and was imported in Japan about 750 A.D. it was extensively cultivated in Japan, USA, India, China and Pakistan (Wealth of India, 1973). A persimmon is the edible fruit of a number of species of trees of the genus Diospyrosin the ebony wood family (*Ebenaceae*). The word Diospyros means "The fruit of the gods" in ancient Greek. The word persimmon is derived from putchamin, pasiminan or pessamin, from Powhatan, an Algonquian language (related to Blackfoot, Cree and Mohican) of the eastern United States meaning "a dry fruit". Persimmon are generally light yellow-orange to dark red-orange in color, and depending on the species, vary in size from 1.5 to 9 cm (0.5 to 4in) diameter, and may be spherical, acron, or pumpkin-shaped. The calyx often remains attached to the fruit after harvesting, but becomes easier to remove as it ripens. They are high in glucose, with a balanced protein profile, and possess various medicinal and chemical uses. While the persimmon fruit is not considered a "common berry" it is in fact a "true berry" by definition.

Persimmon fruit contains about 79% water, 0.4% protein, 0.4% crude fibre and 0.7% pectin (Ito, 1962; Ito and Tada 1969). It is a good source of vitamin A and C (Hkubo et al., 1954; Homnava et al., 1990). The main sugars in flesh of the mature fruit are fructose and glucose, the total amount of which in more than 90% of the total sugar (Ito 1962). In raw friut the soluble sugars are glucose (38%), fructose (39%) and sucrose (23%) (Hirai et al., 1983; Lim et al., 1984). The immature persimmon fruit contains 1.41% water soluble tannins (FWB), which gives astringency to the fruit (Ito, 1971). Persimmon is an important fruit in Japan, China, Europe and Italy and is also gaining popularity in the Mediterranean countries. It is normally marked as fresh fruit but processing of this fruit is of great interest due to its important biologically active compounds (different types of carotenoids and Vitamin C) and astringency associated with unripe hard fruit (Nizakat et al., 2006). The world-wide production of persimmon stands at 4.63 million tons 2013 (FAO, 2013). In 2007, the global production of persimmon reached over 3.3 million tons, with 70% from China, 10% from Korea and 7% from Japan. Mediterranean region is also suitable fir persimmon production that has reached up to the 110,000 tons (Jung et al., 2005; Luo, 2007; Bubba et al., 2009).

Generally, over 400 species of persimmon are planted globally. Among these species, *Diospyros kaki, Diospyros virginiana, Diospyros oleifera* and *Diospyros lotus* have a significant importance (Bibi et al., 2007). Leaves of the persimmon contain pro anthocyanidins (Jung et al., 2005; Suzuki et al., 2005). Which are beneficial against oxidative stress, hypertension, diabetes mellitus and atherosclerosis (Kotani et al., 2000; Wang et al., 2004). In Pakistan it is cultivated in cool subtropical regions of Malakand, Mardan, Hazara, Peshawar, Taxila, Rawalpindi, Chakwal and Jhelum Divisions. It flowers late in the spring and ripens early to late October (Sartaj, 1999). The area under cultivation during 2008-09 was 3217 ha with 34049 tons production (Agriculture statistics of Pakistan 2008-09). The nutritional assessment of the fruit had shown it to be a good source of ascorbic acid, minerals, fibres and carotenoids (Leghari et al., 2021; Shahid et al., 2021; Shahid et al; 2021). In Pakistan the fruit is gaining more popularity. Some varieties grown in Pakistan are Hachiya, Fuyu, Aman kaki, Marko, Italy, Jiro and Gosho. The variety, which is cultivated on commercial basis, is flat in shape and becomes in deep orange color on ripening. This variety is seedless but quite astringent. Persimmon usually have a firmness >2.3 kg of force (using an Effigi penetrometer with an 8mm tip) which then decreases during storage (George et al., 2005).

However, persimmon can soften rapidly within days, sometimes even hours. This softening is initially triggered by ethylene (a natural plant hormone), which is initial trigger for a range of fruit softening enzymes such as polygalacturnase (PG) and pectinesterase (PE) (Luo, 2007, Nikawa et al., 2005). A refractometer directly measure the fruit juice's total soluble solid (TSS) in units called degree Brix. The TSS is virtually the same as the sugar concentration. (George et al., 2008) found that flavour and Brix concentration were highly corrected. Maximum flavour was achieved at a Brix concentration of 18•. If a minimum acceptable flavour rating of 6.5 were set a hedonic scale (1= highly unacceptable, 9=highly acceptable) a ^{o}brix of concentration >16 would be needed to satisfy this standard. Flavour is also genetically determined. Some new Japanese and Chinese varieties appear to have better flavour than 'Fuyu'. Soluble solids and tannin concentration are the two main factors influencing persimmon flavour and repeated purchase by consumers. The rate of deterioration (perishability) of harvested horticulture fruits is proportional to the respiration (Chujo et al., 1982).

Hypobaric treatment is an emerging preservation technology. The mechanism of this technology is to accelerate the outward diffusion of gases such as ethylene, ethanol, and C_{O2} in fruit tissue by increasing the difference between the internal and external pressures of the fruit, thereby maintaining fruit quality during postharvest storage. Previous studies have reported that hypobaric treatment could effectively slow down fruit softening, inhibit colour change and reduce weight loss in jujube, pear and peach (Li et al., 2017; Wang et al., 2007). Moreover, hypobaric treatment is beneficial for nutrient maintenance in fruit, as it effectively inhibits the decreases in the concentrations of organic acid, vitamin C and raw pectin and the increase in anthocyanin concentration during storage (Li et al., 2019; Wang et al., 2007). However, limited research has been reported regarding the influence of hypobaric treatment on off-flavour control during persimmon ripening. Keeping in view the above facts, the objectives of present research are to check the effect of short time hypobaric treatment on persimmon, to check the effect of storage temperature on the storage life and to check the effect of plastic packaging on shelf life of the fruit.

2. Materials and Methods

Fresh, matured and healthy persimmon were purchased from the local Peshawar fruit market and labelled with laboratory code i.e. I, II, III and IV. These persimmons were carried out in Post-Harvest Laboratory Department of Food Science and Technology, The University of Agriculture Peshawar, Pakistan during the year, 2020.

2.1. Processing and storage

2.1.1. Washing

Persimmon were washed with clean water to remove adhering dust and extraneous material and were dried below air or under fan.

2.1.2. Sorting/Trimming

Diseased and bruised persimmon were removed.

2.1.3. Plan of study

Treatment	Temperature	Pressure
T0	Control	—
T1	0 ^{0}C	—
T2	23 ^{0}C	25kpa
T3	0 ^{0}C	25kpa

2.1.4. Packing

Persimmon were packed in plastic box.

2.1.5. Storage

Persimmon were stored at different temperature for 8 days at i.e. room temperature (20-25) and cold temperature (0-5). The product was studied for overall quality analysis at 4 days interval of 8 days storage period.

2.1.6. Hypobaric Treatment

Hypobaric pressure was generated in a hermetically sealed tank with a vacuum pump container. Persimmon were placed inside the tank at 20 °C. The vacuum generated during treatment was measured with a calibrated pressure gauge. Clamshells/containers placed inside the same room at atmospheric pressure (250 kPa) were used as controls. Hypobaric pressure, temperature and relative humidity (RH) inside the chamber were monitored.

2.2. Physicochemical Analysis

2.2.1. TSS (Total Soluble Solids)

Total soluble solids were determined by using hand refractometer at room temperature. The representative sample were placed on dry refractometer prism and readings were taken directly. Results were expressed as soluble (Brix•) as described in AOAC (2000).

2.2.2. Weight loss

Initial net weight of each persimmon was recorded to 0.001 g accuracy using a balance (Mettler Toledo PG 503-S) at 20 °C or 5 °C. Persimmon were reweighed at each storage interval and percentage weight loss from the initial was calculated.

$$\%\ \text{Weight loss} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

2.2.3. Firmness

Firmness of persimmon was measured using penetrometer. Firmness of 3 sound fruits was measured per replicate at each storage interval. Fruit was place at the bottom of the stand while sensing head along the tip was on a line with measuring fruit. Measurement was done by exerting force (push and pull) from top to bottom, the LCD displayed the average reading value.

2.2.4. Shrinkage

Shrinkage ratio of the fruit was determined by measuring length and width using digital caliper. Length in mm was added to width in mm and then divided by two to get average value. Final values were subtracted from initial values to get shrinkage.

2.3. Organoleptic evaluation

Selected samples of persimmon pulp were evaluated organoleptically overall acceptability by the panel of 10 judges. Sensory evaluation was carried out by using 9 points hedonic scale of Larmond (1977).

2.4. Statistical analysis

Data acquired from different parameters was analyzed statistically by using software Statistica 8.1 to find the level of significance.

3. Results and Discussion

3.1. Total Soluble Solid (TSS)

Initially TSS was 17.75 which was gradually increased to 21.25. As we see that the TSS increase slowly it is because of the loss of Moisture due to which the content condenses and the TSS increases as Shown in Table 1. The increase in total soluble solid might be due to the partial hydrolysis of complex polysaccharides and solubilisation of fruit consistently during storage. Ehsan et al., (2003) revealed the similar increase in total soluble solid values from (70 to 70.8 ^{o}brix) in lemon jammed water melon jam.

Table: 1. Effect of Hypobaric treatment and storage on TSS (^{o}Brix) of selected persimmon fruit.

Treatments	Storage Interval (Days)				
	0	03	05	08	Means
T0	17	18	19	23.5	19.12
T1	18	18	17.6	20.5	18.52
T2	17	19.5	19.3	21.5	19.32
T3	19	20	17.5	19.5	19.00
Means	17.75	18.87	18.35	21.25	

3.2. Shrinkage (%)

Fruit volume of persimmon fruit was significantly affected by storage duration whereas the effect of treatment and their interactions were found non-significant. Fruit volume decreased due to the gas exchange and also the result of water vapour loss during storage. The respiration rate increases in fruits having significant effect on fruit volume, being responsible for 24% percent of the total mass loss during storage (Maguire et al, 2000). The higher respiration rate and O_2 uptake of fruit stored result in chemical changes in fruits. Other studies showed that the mass loss as a result of water vapour loss increased the accumulation of soluble solid during storage (Brackmann et al, 2004; Brackmann et al, 2007; Pinto et al., 2012).

Table: 2. Shrinkage (%) in fruit volume of persimmon fruits during storage.

Treatments	Storage Interval (Days)				
	0	**03**	**05**	**08**	**Means**
T0	1.26	2.15	4.4	6.16	3.49
T1	0.90	1.26	1.06	3.23	1.61
T2	2.15	3.46	4.76	6.06	4.10
T3	0.50	0.74	1.14	2.64	2.61
Means	1.20	1.90	2.84	4.52	

3.3. Firmness (N)

Firmness is an important quality parameter, which dictates the commercial value of fruits (Angeletti et al., 2010). At 20°C persimmon firmness remained constant for 4 days after treatment and then decreased approximately 30% at 7 days of storage with significant influence ($P<0.05$). At 0 °C there was no significant difference between treatments at 8th day of storage despite the 25 kPa had a consistently greater firmness than the control fruit for the majority of the experiment as shown in Table 3.

Table: 3. Firmness (N) of persimmon fruit during storage.

Treatments	Storage Interval (Days)				
	0	**03**	**05**	**08**	**Means**
T0	1.20	1.20	1.03	0.25	0.92
T1	1.18	1.05	1.09	1.01	1.08
T2	2.02	1.05	1.14	1.02	1.30
T3	1.91	1.10	0.76	1.03	1.2
Means	0.88	1.37	2.5	9	

3.4. Weight Loss (%)

Hypobaric conditions reduce the boiling point of water and as a result fruit and vegetables lose water vapour, therefore high humidity should be maintained during low pressure (Thompson, 2010). In this experiment persimmon treatment with 25kPa for 4 h had no effect on the weight of samples in either post treatment storage conditions. As a general rule weight loss of more than 5% reduces the retail value of fresh produce (Ohta et al., 2002). In this experiment 5% weight loss was observed in both treated and control samples after 6 days at 20°C and after 35 days at 0 °C as shown in Table 4. Almenar et al. (2008) reported a weight loss of 19% in persimmon stored in clamshells at 23°C (84% RH) and 7% in persimmon stored at 10°C (66% RH) after 6 days.

Table: 4. Weight Loss (%) of persimmon fruit during storage.

Treatments	Storage Interval (Days)				
	0	**03**	**05**	**08**	**Means**
T0	1.32	2	4	7	3.58
T1	0.5	1	1	4	3.37
T2	1.5	2	4	6	1.62
T3	0.20	0.50	1	1	0.55
Means	0.88	1.37	2.5	9	

3.5. Organoleptic evaluation

The samples were sensory evaluated for overall acceptability at storage interval of 15 days for total period of by a panel of 10 judges experienced in organoleptic evaluation. The evaluation was carried out by using point hedonic scale of Larmond (1977). Initially the mean score of judges for overall acceptability of persimmon sample T0 to T3 were 9, 8.7 and 6 which gradually decreased to 6, 5, 3, and 1 respectively during storage. For treatment maximum mean value was observed in T1 (7) followed by T3 (6.5) while minimum means value was observed in T0 (4.7) followed by T2 (5.2) as shown in Table 5.

Table: 5. Mean score of overall acceptability for persimmon fruit during storage.

Treatments	**Storage Interval (Days)**				
	0	**03**	**05**	**08**	**Means**
T0	7	6	5	1	4.7
T1	9	7	7	5	7
T2	6	6	6	3	5.2
T3	8	7	6	5	6.5
Means	7.5	6.5	6	3.5	

4. Conclusion

Rapid softening of persimmon within days or sometimes even hours necessitates novel post-harvest and processing techniques to maintain nutritional as well as organoleptic quality of this fruit. Present study was conducted to evaluate the effect of hypobaric treatment on quality and shelf life of persimmon fruit. It was concluded from the results that 25kpa was effective in reducing moisture content as a result slowing down the activity of ripening enzymes increasing the shelf life and overall acceptability of this highly perishable fruit.

Corresponding Author
Dr. Ali Muhammad
Assistant Professor
Email: alizypher@yahoo.com
Department of Food Science & Technology
The University of Agriculture, Peshawar
25130, Khyber Pakhtunkhwa, Pakistan.

References

1. Ali, M., M. M. Liu, Z. E. Wang, S. E. Li, T. J. Jiang, and X. L. Zheng, 2019. Pre-harvest spraying of oxalic acid improves postharvest quality associated with increase in ascorbic acid and regulation of ethanol fermentation in kiwifruit cv. Bruno during storage. Journal of Integrative Agriculture, 18, 2514–2520. https://doi.org/10.1016/s2095-3119(19)62791-7.
2. Angeletti, P., H. Castagnasso, E. Miceli, L. Terminiello, A. Concellón, A. Chaves, and A. R. Vicente. 2010. Effect of preharvest calcium applications on post-harvest quality, softening and cell wall degradation of two blueberry (Vaccinium corymbosum) varieties. Postharvest Biol. Technol. 58:98-103.
3. Barry, C. S. and J. J. Giovannoni. 2007. Ethylene and fruit ripening. Journal of Plant Growth Regulation, 26: 143–159. https://doi.org/10.1007/s00344-007-9002-y.
4. Bibi N., A. B. Khattak and Z.Mehmood.2006. Quality improvement and self-life extension of persimmon fruit (Diospyros kaki). J. Food Engr. 79(4):1459-1363.
5. Bibi, N., A. B. Khattak, Z. Mehmood. 2007. Quality improvement and shelf life extension of persimmon fruit Diospyros kaki. J Food Eng.;79; 1359-63.
6. Broadley, R. H., and A. P. George. 2007. Short Report on New Zealand Persimmon Industry, May 2007. Department of Primary Industries & Fisheries, Nambour, Department of Primary Industries and Persimmons Australia Inc. pp.38.
7. Broadley, R.H., A. P. George, R. J. Nissen, and S. Jeffers. 2007. Persimmon RD and E – the way forward. Findings from the 4th International Persimmon Symposium. November 2008. Internal Report for Queensland film on postharvest fruit softening of 'Tonewase' Japanese persimmon. Horticultural Research (Japan) 5,185-191.
8. George, A., B. Nissen, R. Broadley, R. Collins, P. Rigden, S. Jeffers, B. Isaacson, and S.Ledger.2005. Sweet Persimmon Grower's Handbook. Queensland Department Primary Industries and Fisheries Information Series qi05102.
9. George, A.P. and Redpath, S. 2008. Health and medicinal benefits of persimmon fruit: a review. Advances in Horticultural Science, 22(4):244-249.
10. George, A.P., S. Redpath, H. and Gugger. 2008. Report on the Italian and Spanish Persimmon Industries and Key.
11. Harima, S., R. Nakano, A. Inaba, and Y. Kubo. 2006. Effect of trunk girdling and mulching with reflective plastic.
12. Harima, S., R. Nakano, T. Yamamoto, H. Komatsu, K. Fujimoto, Y. Kitano, Y. Kubo, A. Inaba, E. and Tomita. 2001. Postharvest fruit softening in forcing-cultured 'Tonewase' Japanese persimmon (Diospyros kaki Thunb). Journal of the Japanese Society for Horticultural Science 70, 251-257.
13. Hashmi, M. S., A. R. East, J. S. Palmer, J. A. Heyes,.2013a. Hypobaric treatment reduces fungal rots in blueberries. Acta hort. 1012: 609–614.

14. Hashmi, M. S., A. R. East, J. S. Palmer, J. A. Heyes. 2013c. Pre-storage hypobaric treatments delay fungal decay of strawberries. Postharvest Biol. Technol. 77, 75–79.
15. Leghari AA, Shahid S, Farid MS, Saeed M, Hameed H, Anwar S, Nishat Z, Shahid MK, Meraj A. 2021. Benificial aspects of prbiotics, strain selection criteria and microencapsulation using natural biopolymers to enhance gastric survival: A review. Life Sci J. 18 (1): 30-47.
16. Proceedings of the 2007 Australian Custard Apple and Persimmon Conference. (R.H. Broadley, P. Broadley, L.M. Taylor and S.D. Price, eds.): 231-233.
17. Shahid S, Leghari AA, Farid MS, Saeed M, Anwar S, Anjum R, Saeed N, Abbas Z. 2021. Role of Active Food Packaging Developed from Microencapsulated Bioavtive Ingredients in Quality and Shelf Life Enhancement: A review. J Am Sci. 17 (2): 12-28.
18. Shahid S, Leghari AA, Anam M, Gull T, Ashraf J, Tahir H, Liaqat H, Iqbal MW. 2021. Development of Yoghurt Spread from Goat Milk and its Qualitative Valorization Using Chia Seed Oil. Adv Food Technol Nutr Sci. 7 (1): 7-12.
19. Thompson, A. K. 2010. Controlled Atmosphere Storage of Fruits and Vegetables. CABI. 612.
20. Tournas, V. H. and E. Katsoudas. 2005. Mould and yeast flora in fresh berries, grapes and citrus fruits. Intl. J. Food Microbiol. 105:11-17.
21. Wang, Q., T. Lai, G. Qin, S. and Tian. 2009. Response of jujube fruits to exogenous oxalicacid treatment based on proteomic analysis. Plant Cell Physiol. 50 (2), 230–242.
22. Wang, Y., M. Zhang, D. Wang, H. He, L. Li, and G. Wang. 2015. Multivariate analysis of hypobaric treatment on fruit quality and active oxygen metabolism of strawberry during postharvest ripening. J. Chin. Inst. Food Sci Technol. 15 (6): 231–239.
23. Wang, Y.S., S. P. Tian, Y. Xu, G. Z. Qin, H. Yao. 2004. Changes in the activities of pro-and anti-oxidant enzymes in peach fruit inoculated with Cryptococcus laurentii or Penicillium expansum at 0 or 20°C. Postharvest Biol. Technol. 34 (1), 21–28.
24. Wealth of India (part VI) originally published in 1960 modified in 1973. Editor Shri. S. M. Sen. Gupta.
25. Wu, J.H., W. Q. Wang, S. Q. Song, and H. Y. Cheng. 2009. Reactive oxygen species scavenging enzymes and down-adjustment of metabolism level in mitochondria associated with desiccation-tolerance acquisition of maize embryo. J. Integr. Plant Biol. 51 (7): 638–645.

2/25/2021